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| APPLICATION NO. | FILING DATE | FIRST NAMED INVENTOR | ATTORNEY DOCKET NO. | CONFIRMATION NO. |
|---|---|---|---|---|
| 09/912,068 | 07/23/2001 | Song Zhang | 10.1017 | 3277 |

21919 7590 02/10/2006

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| TRAN, KHANH C | |
| **ART UNIT** | **PAPER NUMBER** |
| 2631 | |

DATE MAILED: 02/10/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

| Office Action Summary | Application No. | Applicant(s) |
|---|---|---|
| | 09/912,068 | ZHANG ET AL. |
| | Examiner | Art Unit |
| | Khanh Tran | 2631 |

***-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --***

**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

1)☒ Responsive to communication(s) filed on *16 November 2005*.

2a)☐ This action is **FINAL**.   2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

4)☒ Claim(s) *2-23,25,26 and 28-48* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☒ Claim(s) *25,26 and 28-37* is/are allowed.

6)☒ Claim(s) *2-23 and 38-46* is/are rejected.

7)☒ Claim(s) *47 and 48* is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

**Application Papers**

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

**Priority under 35 U.S.C. § 119**

12)☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☒ All b)☐ Some * c)☐ None of:

1.☒ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

**Attachment(s)**

1) ☐ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

## DETAILED ACTION

1. The Amendment filed on 11/16/2005 has been entered. Claims 2-23, 25-26 and 28-48 are pending in this Office action.

### *Response to Arguments*

2. Applicant's arguments with respect to claims 2-3, 12, 15-24, 35 and 39-46 have been considered but are moot in view of the new ground(s) of rejection.

### *Claim Rejections - 35 USC § 103*

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

3. Claims 2-17, 20-23, 38-39, 42-45 are rejected under 35 U.S.C. 103(a) as being unpatentable over Jin U.S. Patent 6,671,327 in view of John G. Proakis "Digital Communications", third edition, 1995.

Regarding claim 4, Jin discloses in the abstract of the cited US patent a method for transmitting data over a communications channel.

In regarding to the claimed step of "*dividing said sequence of information bits into encoding bits and parallel bits*", as shown in one embodiment in figure 3, input bits

arrive in parallel, wherein a portion of an incoming bit stream is fed to encoder data block 10. As result of that, the foregoing disclosure impliedly addresses the claimed step, see column 2, lines 43-49.

In regarding to the claimed step of "*encoding said encoding bits to produce encoded bits*", as recited above, a portion of an incoming bit stream is fed to encoder data block 10. Outputs from data block 10, comprising three bits $u_1$ $u_2$ $u_3$ and three bits $u'_1$ $u'_2$ $u'_3$ are passed through turbo encoder 20 to produce encoded bits.

In regarding to the claimed step of "*mapping said encoding bits and parallel bits into first and second pulse amplitude modulation (PAM) signals*", Jin does not expressly teach the step of mapping as set forth in the claim. However, Jin expresses that a constellation encoder structure employed is similar to that used in an ADSL system in which a quadrature amplitude modulation (QAM) modulator is usually employed. In column 2 line 62 via column 3 line 40, Jin further teaches the binary word u determines two binary words v and w, which are used to look up two constellation points (e.g. x and y bits as shown in figures 6 and 7) in the encoder look-up table.

John G. Proakis discloses on pages 178-179 in the textbook "Digital Communications", third edition, 1995, quadrature amplitude modulation (QAM) is a result of simultaneously impressing two separate k-bit symbols from the information sequence on two-quadrature carriers $\cos 2\pi f_c t$ and $\sin 2\pi f_c t$. In view of that, it would have been obvious for one of ordinary skill in the art at the time of the invention that Jin teachings can be modified to map the encoded bits and parallel bits into first and second PAM signals. Motivation is that Jin teachings apply to ADSL system in

which a quadrature amplitude modulation (QAM) modulator is usually employed. Furthermore, figures 6 and 7 show the constellation how the final three bits are mapped and the constellation showing how the determination of the most significant bits.

Jin does not expressly teach the step of identifying a number of the information bits being odd and even as claimed by Applicants.

In column 3 lines 2-20, Jin teaches the length of data block depends on the number of data being transmitted in each signal frame, 9500 bits in the example given above. Because the number of data being transmitted in each signal frame can be odd or even, therefore, one of ordinary skill in the art would have recognized that Jin teachings would identify the length of data block and can be modified to determine if the number of data being transmitted in each signal frame can be odd or even.

Regarding claim 2, the modulation scheme taught in Jin invention is for transmitting data over a communication channel. As a result of that, the method in claim 1 further includes a step of transmitting a QAM signal over a communication channel.

Regarding claim 3, Jin invention is directed to a modulation scheme for transmitting data over a communication channel, in a discrete multi-tone modulation (DMT) system. Jin further teaches that the constellation encoder structure employed is similar to that used in an ADSL system. Because Jin teachings reference the modulation scheme to DSL modulation system and ADSL system, it would have been

obvious for one of ordinary skill in the art at the time the invention was made that Jin invention can be implemented in ADSL communication system.

Regarding claim 5, Jin teaches that the turbo coder is preferably used to code only the least significant bit (LSB) in the constellation since the LSB is most sensitive to errors. Figures 1, 2 and 3 illustrate the encoder structures in three cases. Therefore, because the length of data block depends on the number of data being transmitted (e.g. odd or even) in each signal frame, one of ordinary skill in the art would have recognized that different mode of operation can be selected based on the odd or even status of the number of the information bits.

Regarding claim 6, in column 3 lines 4-40, Jin teaches that FIG. 1 shows the encoder structure for x>1 and y>1, where the turbo encoder used is a systematic encoder with coding rate 3/4 punctured at rate 1/2. FIG. 2 shows the encoder structure for x=1 and y>1, where the turbo coding rate is 2/3. For the case y=1 and x>1, the encoder structure, shown in FIG. 3, is similar to that shown in FIG. 2. FIG. 3 shows the encoder structure for the case x=y=1, where the coding rate is ½. The x and y represent the number of bits in the encoder look-up table. In light of the foregoing disclosure, each mode of operation determines all the parameters as claimed in the application claim.

Regarding claim 7, because Jin teaches more than two modes of operation as shown in figures 1-4, Jin teachings render the claimed limitation obvious.

Regarding claim 8, in column 2 lines 40-55, Jin gives an example of even number of information bits, e.g. 9500 bits. Figure 2 shows the number of encoding bits being two.

Regarding claim 9, claim 9 is rejected on the same ground as for claim 8 because of similar scope. Furthermore, figure 1 shows the number of encoding bits being three.

Regarding claim 10, Jin does not expressly teach if a number of the information bits are odd, a number of the coding bits are three.

Jin teaches in figure 1 that three bits are encoded. Jin teachings further disclose the length of the data block depends on the number of data being transmitted in each signal frame; see column 3 lines 10-15. As a result of that, one of ordinary skill would have recognized the number of data could be odd number of information bits or even number of information bits. Because of Jin teachings of different modes of operation of the encoder structures as shown in figures 1-4, it would have been obvious for one of ordinary skill in the art at the time the invention was made that the claimed limitations are held to be an obvious matter of design choice as taught in Jin invention; see *In re Kuhle, 526 F.2d 553, 188 USPQ 7 (CCPA 1975).*

Regarding claim 11, claim 11 is rejected on the same ground as for claim 10 because of similar scope. Jin teaches encoding 3 least significant bits, 2 least significant bits and one least significant bit as shown in figures 1-4. Hence, it would have been obvious for one of ordinary skill in the art at the time the invention was made that the claimed limitations (e.g. a number of the coding bits greater than three) are held to be an obvious matter of design choice as taught in Jin invention.

Regarding claim 12, in column 2 lines 40-50, Jin teaches two subchannels include a check bit, which is a parity bit. Because Jin teaches encoding the least significant bits in the constellation since the LSB is most sensitive to errors, the check bit is included in the encoded bits. Referring to figure 1, in column 3 lines 1-15, the turbo encoder 20 consists of two recursive systematic convolutional encoders 12 and 14. Therefore, the encoded bits include systematic bits.

Regarding claim 13, claim 13 is rejected on the same ground as for claim 10 because of similar scope. Referring to figure 1, in column 3 lines 1-15, the turbo encoder 20 consists of two recursive systematic convolutional encoders 12 and 14. Furthermore, Jin teaches encoding 3 least significant bits, 2 least significant bits and one least significant bit as shown in figures 1-4. Hence, it would have been obvious for one of ordinary skill in the art at the time the invention was made that the claimed limitations (e.g. a number of the coding bits greater than three) are held to be an obvious matter of design choice as taught in Jin invention. Furthermore, for an even

number of information bits, an even number of parity bits are selected, in this case, two-parity check bits.

Regarding claim 14, claim 14 is rejected on the same ground as for claim 10 because of similar scope. Referring to figure 1, in column 3 lines 1-15, the turbo encoder 20 consists of two recursive systematic convolutional encoders 12 and 14. Furthermore, Jin teaches encoding 3 least significant bits, 2 least significant bits and one least significant bit as shown in figures 1-4. Hence, it would have been obvious for one of ordinary skill in the art at the time the invention was made that the claimed limitations (e.g. a number of the coding bits greater than three) are held to be an obvious matter of design choice as taught in Jin invention. Jin teaches two subchannels include a check bit, which is a parity bit.

Regarding claim 15, as recited in claim 12, referring to figure 1, in column 3 lines 1-15, the turbo encoder 20 consists of two recursive systematic convolutional encoders 12 and 14.

Regarding claim 16, referring to figure 4, encoding is performed by multiple encoders 12 14.

Regarding claim 17, the turbo encoder in figure 4 is a serial concatenated turbo encoder.

Regarding claims 20 and 42, figure 3 illustrates the encoded bit form a binary word w, and the unencoded bits form another binary word u, which are used to look up two constellation points, corresponding to the claimed forming a first vector and a second vector.

Regarding claims 21 and 43, in column 2, line 63 through column 3 line 2, Jin discloses the two binary words v and w used to look up two constellation points. In view of that, the binary words are mapped into the first PAM signal and second PAM signal as recited in claim 1.

Regarding claims 22 and 44, shown in figure 3, w only includes encoded bits and v only includes parallel bits. Hence, each of the first PAM signal and second PAM signal is formed from alternate ones of the encoded bits and parallel bits.

Regarding claims 23 and 45, in column 1 lines 61-65, Jin teaches that the turbo coder is preferably used to code only the least significant bit (LSB) in the constellation. In view of that, alternating ones of encoded bits form least significant bits, and alternate ones of parallel bits form most significant bits of each of PAM signals.

Regarding claim 38, claim 38 is rejected on the same ground as for claim 4 because of similar scope. Furthermore, referring to figure 1, in column 3 lines 1-20, the

turbo encoder 20 consists of two recursive systematic convolutional encoders 12 and 14.

Regarding claim 39, claim 39 is rejected on the same ground as for claim 17 because of similar scope.

4. Claims 18 and 40 are rejected under 35 U.S.C. 103(a) as being unpatentable over Jin U.S. Patent 6,671,327 in view of John G. Proakis "Digital Communications", third edition, 1995 as applied to claim 1 and further in view of David G. Williams, **"Turbo product codes and their bandwidth efficiency",** IEEE Colloquium on 22 Nov. 1999 Page(s): 6/1 – 629.

Regarding claim 18, Jin does not teach that encoding is performed by a turbo product code encoder as claimed in the application claim.

David G. Williams discloses on page 1 the Turbo Product Codes providing excellent means of improving bandwidth efficiency. Jin teaches using a turbo encoder to generate turbo encoded output bits. As discloses on page 1, David G. Williams discloses Turbo Product Codes are extension of Turbo codes; therefore, it would have been obvious for one of ordinary skill in the art at the time of the invention that Jin teaching can be modified to use Turbo Product Codes as taught in David G. Williams' paper. Motivation is described on the paper that Turbo Product Codes providing excellent means of improving bandwidth efficiency.

Regarding claim 40, claim 40 is rejected on the same ground as for claim 18 because of similar scope.

5. Claim 19 and 41 are rejected under 35 U.S.C. 103(a) as being unpatentable over Jin U.S. Patent 6,671,327 in view of John G. Proakis "Digital Communications", third edition, 1995 as applied to claim 1 and further in view of Lentmaier, M.; Zigangirov, K.S. "**Iterative decoding of generalized low-density parity-check codes",** Information Theory, 1998. Proceedings. 1998 IEEE International Symposium on 16-21 Aug. 1998 page(s): 149.

Regarding claims 19 and 41, Jin does not teach that encoding is performed by a low-density parity check (LDPC) encoder as claimed in the application claim.

Lentmaier, M. and Zigangirov, K.S. teach the use of low-density (LD) parity-check codes in combination with iterative decoding. Lentmaier, M. and Zigangirov, K.S. further expresses that LDPC are promising for achieving low error probabilities at a reasonable cost. Therefore, therefore, it would have been obvious for one of ordinary skill in the art at the time of the invention that Jin teaching can be modified to use LDPC as taught in Lentmaier, M. and Zigangirov, K.S.'s paper.

6. Claim 46 is rejected under 35 U.S.C. 103(a) as being unpatentable over Jin U.S. Patent 6,671,327 and John G. Proakis "Digital Communications", third edition, 1995 as applied to claim 4 above, and further in view of Gelblum et al. U.S. Patent 6,088,387.

Regarding claim 46, Jin and John G. Proakis disclose all the claimed limitations, but do not teach mapping is a concatenated Gray mapping. Gelblum et al. teaches a similar apparatus for implementing turbo code and trellis code modulation in a multi tone communications environment. Figure 1 illustrates a modem in which a portion of information bits is turbo coded and the other information bits are uncoded. Referring to figure 2, in column 5 lines 37-45, the assignments of bits to the M-QAM symbols can employ any suitable mapping scheme as Gray mapping, which is well known in the art. Because of the known potential advantage of Gray mapping, one of ordinary skill in the art would have been motivated to implement Gray mapping into Jin system.

***Allowable Subject Matter***

7. Claims 25-26 are allowed.

The following is a statement of reasons for the indication of allowable subject matter:

Regarding claim 25, claim is allowable over prior art of record because the cited references cannot teach or suggest the allowable claim subject matter "*said concatenated Gray mapping is a serial concatenation of an inner Gray mapping and an outer Gray mapping*".

8. Claims 28-37 are allowed.

The following is a statement of reasons for the indication of allowable subject matter:

Regarding claim 28, claim is allowable over prior art of record because the cited references cannot teach or suggest the allowable claim subject matter "*a control unit configured to identify whether a number of said information bits is odd or even*".

9. Claims 47-48 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

## *Conclusion*

10. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Khanh Tran whose telephone number is 571-272-3007. The examiner can normally be reached on Monday - Friday from 08:00 AM - 05:00 PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Mohammad Ghayour can be reached on 571-272-3021. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

KCT

Khanh cong Tran 01/31/2006

Examiner KHANH TRAN